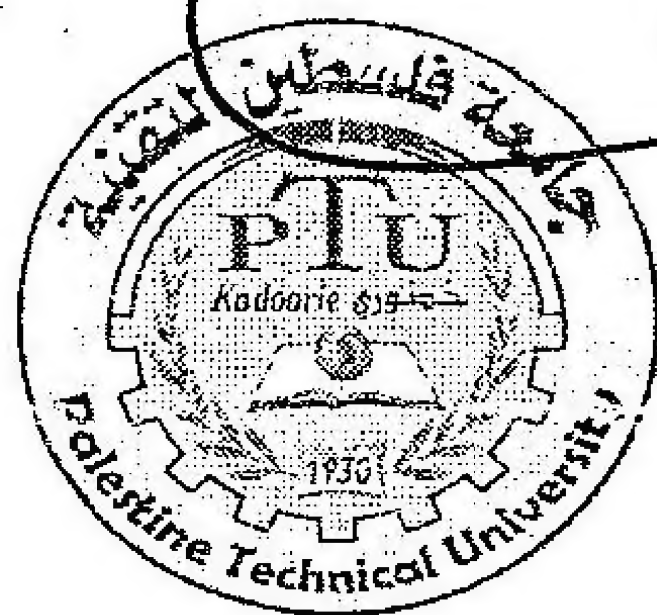


ENGINEERING
Electric circuits 1
29/11/2010
90 m

التخصص والمستوى :
اسم المساق :
تاريخ الامتحان :
زمن الامتحان :



26/30

السلطة الوطنية الفلسطينية

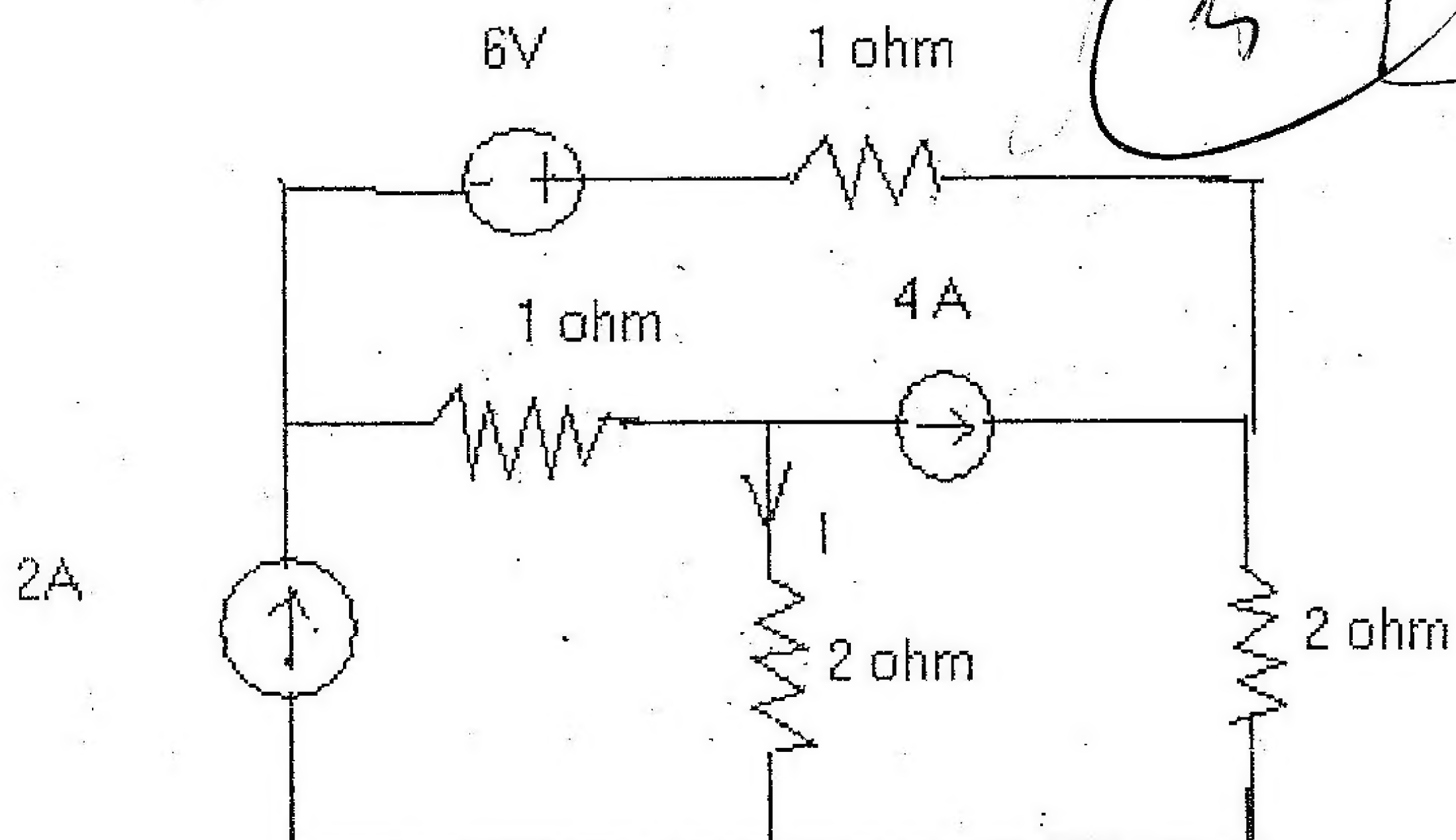
جامعة فلسطين التقنية طولكرم "خضوري"

second exam 2010/2011

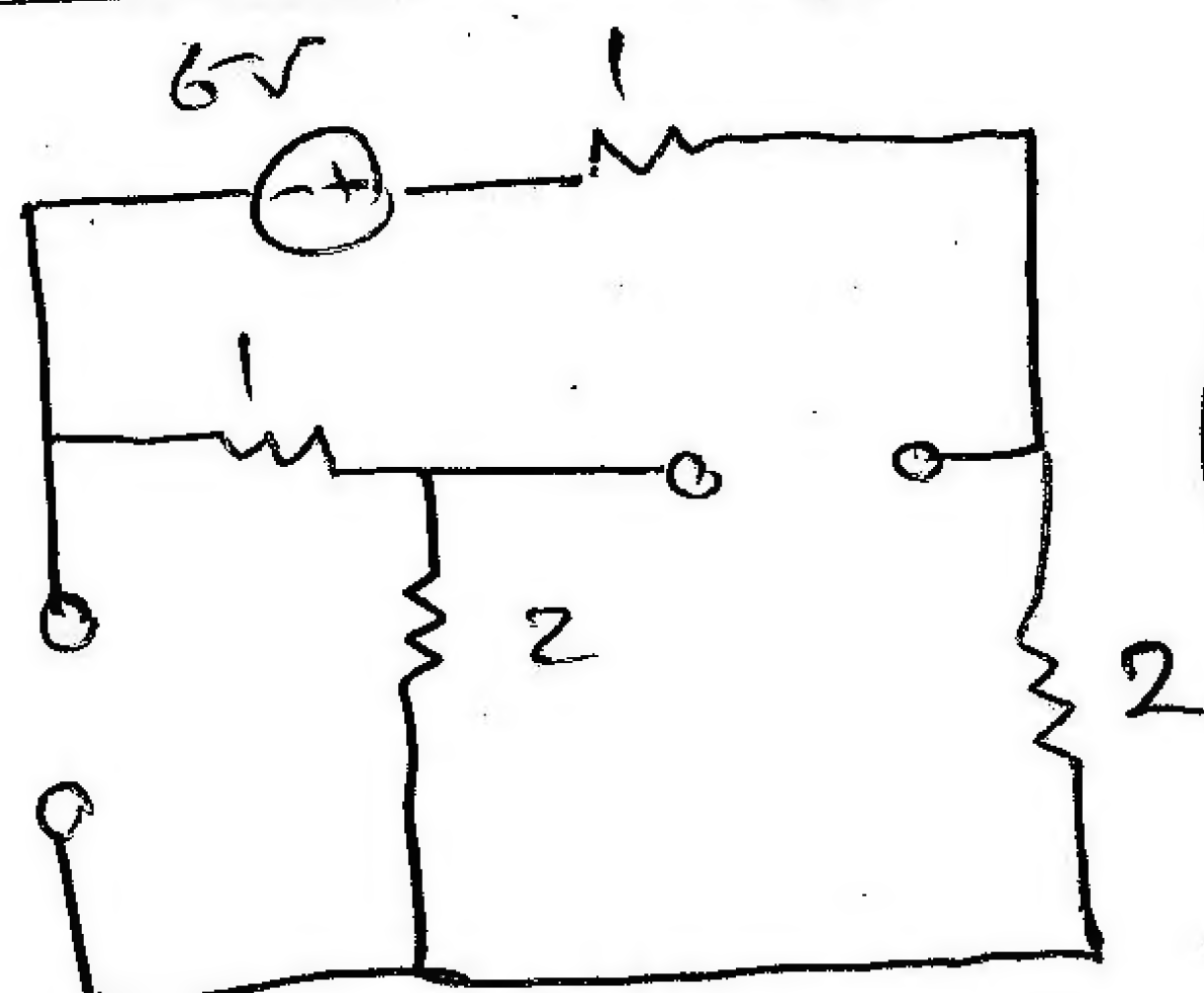
الاسم : معن سلام محمود قعدان الشعبة : احد لواء حبيس 8-9

Q1) Using superposition find I in the following circuit

(6 Marks)



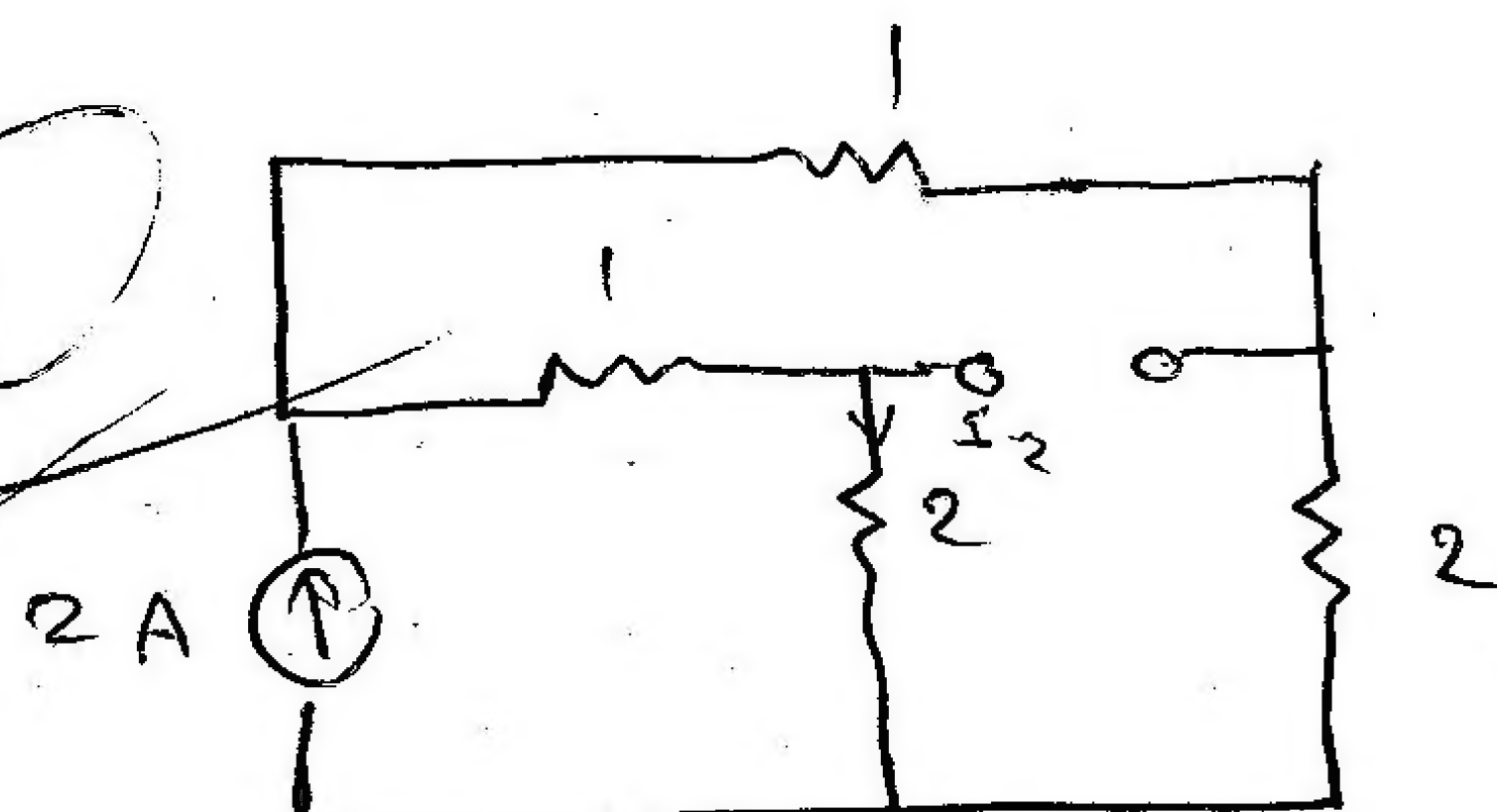
⊗ From 6 V Source



$$V = IR \Rightarrow I_1 = \frac{V}{R} = \frac{6}{1+1+2+2} = \frac{6}{6} = 1A$$

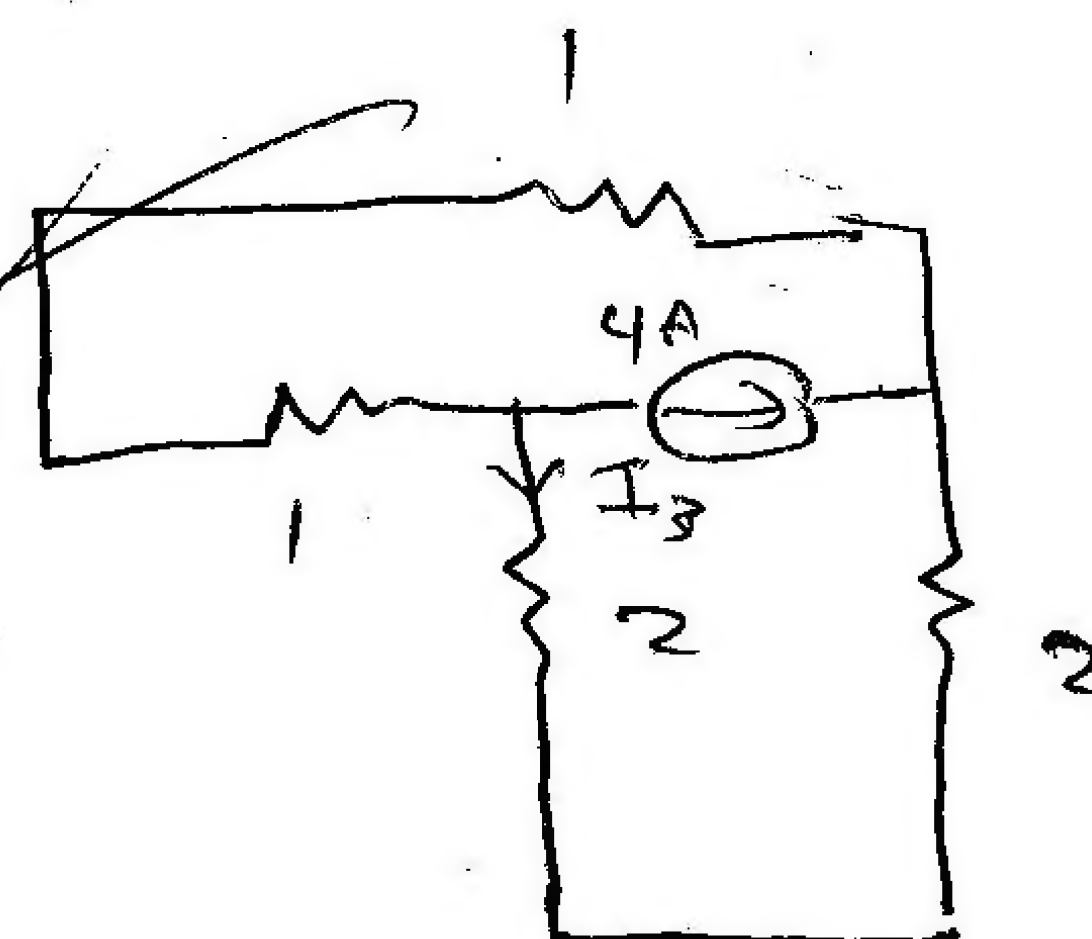
⊗ From 2 A Source

$$I_2 = 2 \left(\frac{2+1}{2+1+2+1} \right) = 2 \left(\frac{3}{6} \right) = 1A$$



⊗ From 4 A Source

$$I_3 = -4 \left(\frac{2}{4+2} \right) = -4 \left(\frac{2}{6} \right) = -\frac{8}{6} = -1.33A$$

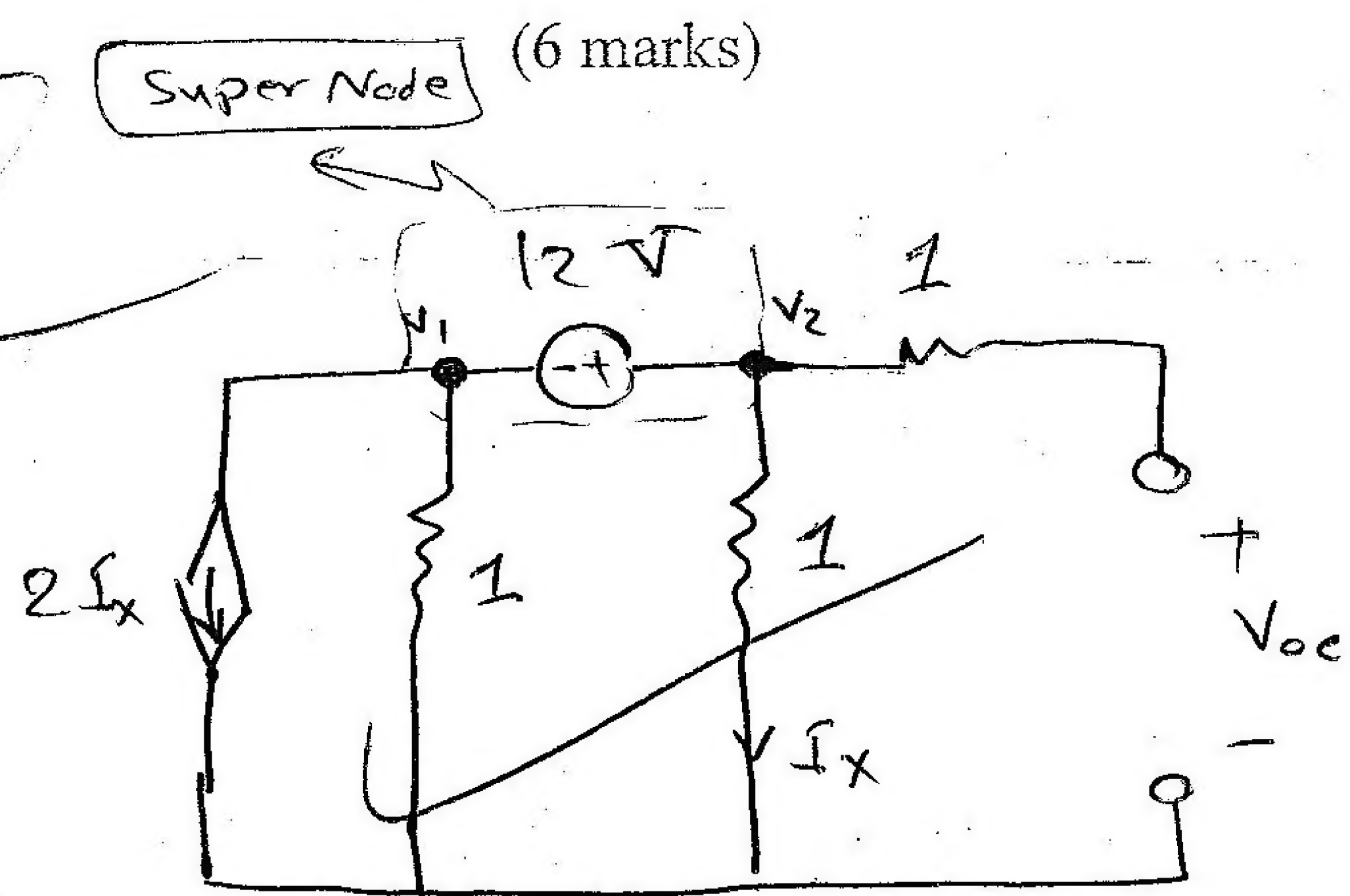
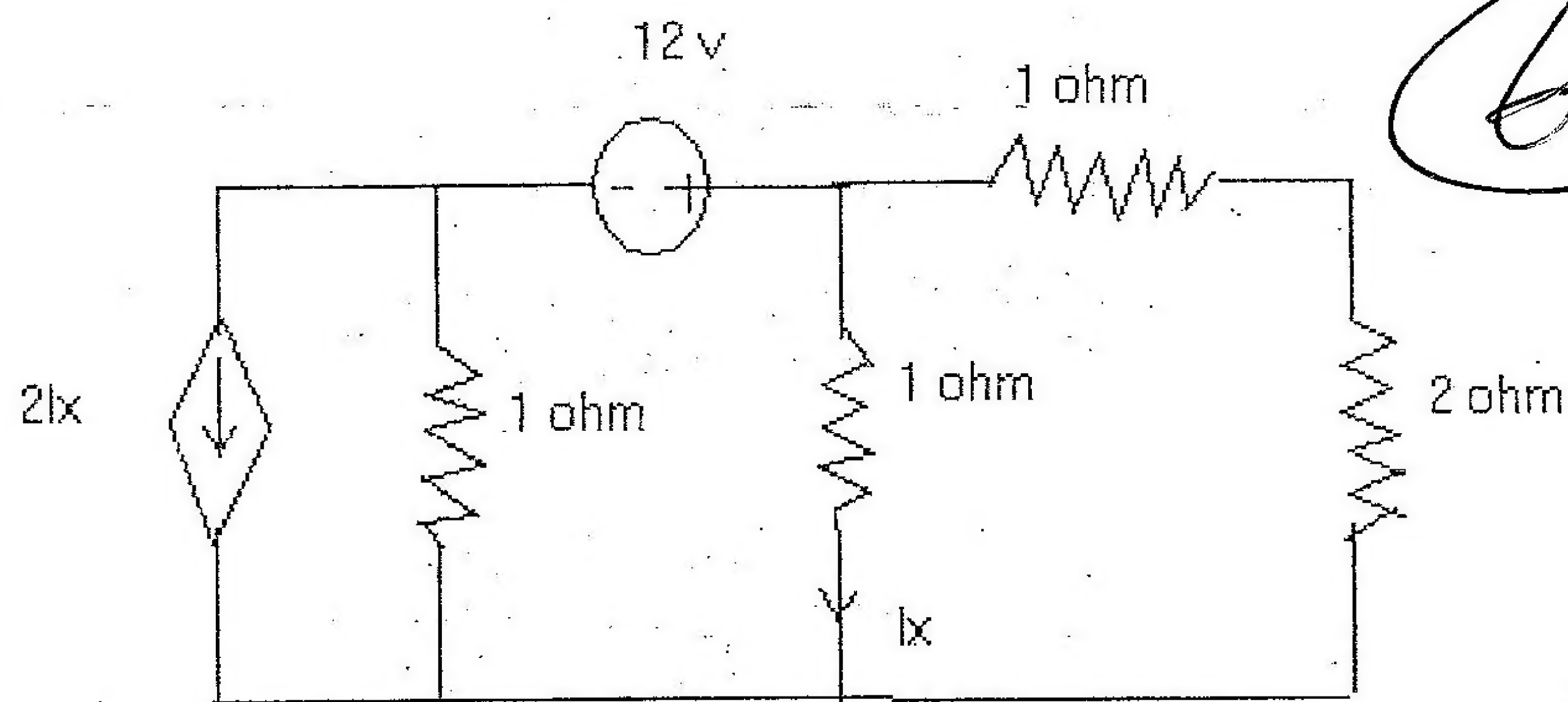


$$\therefore I_{tot} = I_1 + I_2 + I_3 = 1 + 1 - 1.33 = 0.67A$$

تم ارفع بواسطة معن ابو عيسى

Q2) Using Thevenin theorem find the power of the 2-Ω resistor

(6 marks)



⊕ To find V_{TH} , Remove the Load and find V_{oc}

Using Nodal Analysis :-

We have a super Node here

$$\begin{aligned} \text{⊕} \quad & \frac{V_1}{1} + 2I_x + \frac{V_2}{1} = 0 \\ & I_x = \frac{V_2}{1} \\ & \Rightarrow \frac{V_1}{1} + 2V_2 + V_2 = 0 \Rightarrow V_1 + 3V_2 = 0 \quad \text{--- (1)} \end{aligned}$$

$$\text{⊕ From super Node} \Rightarrow V_2 - V_1 = 12 \quad \text{--- (2)}$$

$$\begin{aligned} \therefore V_1 + 3(12 + V_1) &= 0 \Rightarrow V_1 + 36 + 3V_1 = 0 \\ 4V_1 + 36 &= 0 \Rightarrow V_1 = \frac{-36}{4} = \boxed{-9V} \end{aligned}$$

$$\begin{aligned} V_2 - V_1 &= 12 \Rightarrow V_2 - (-9) = 12 \\ V_2 + 9 &= 12 \Rightarrow V_2 = \boxed{3V} \end{aligned}$$

$$\therefore V_2 = V_{oc} = V_{TH} = \boxed{3V}$$

⊕ To find R_{TH}

Using Nodal

$$\therefore \frac{V_1}{1} + 2I_x + \frac{V_2}{1} + \frac{V_2}{1} = 0$$

$$V_1 + 2V_2 + V_2 + V_2 = 0$$

$$V_1 + 4V_2 = 0 \quad \text{--- (1)}$$

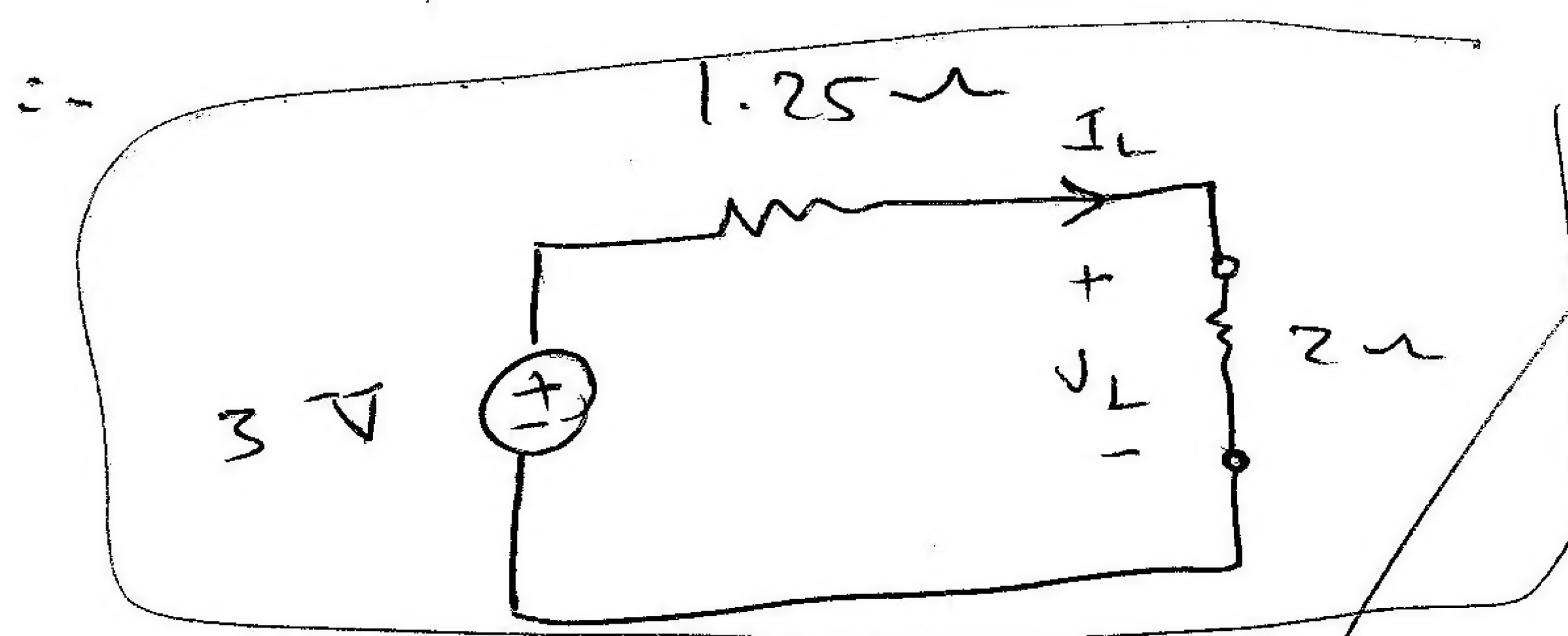
$$V_2 - V_1 = 12 \Rightarrow V_2 = 12 + V_1 \quad \text{--- (2)}$$

$$\begin{aligned} \therefore V_1 + 4(12 + V_1) &= 0 \Rightarrow V_1 + 48 + 4V_1 = 0 \\ 5V_1 + 48 &= 0 \Rightarrow V_1 = \frac{-48}{5} = \boxed{-9.6V} \end{aligned}$$

$$V_2 = 12 + V_1 = 12 - 9.6 = \boxed{2.4V}$$

$$\therefore I_{sc} = \frac{V_2}{1} = \boxed{2.4 \text{ A}}$$

$$\therefore R_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{3}{2.4} = \boxed{1.25 \Omega}$$

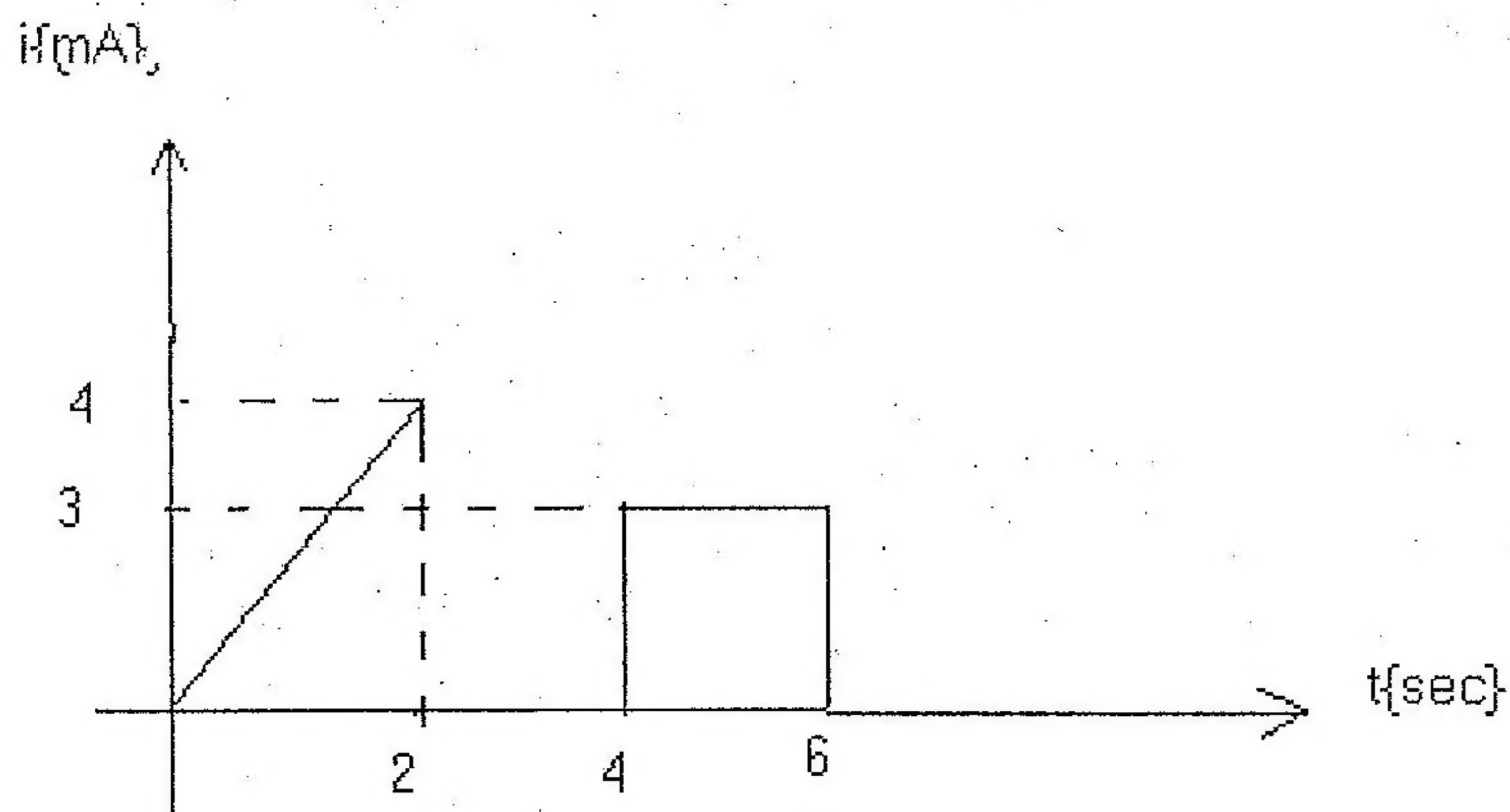


Thevenin
Equivalent
Circuit

$$P_{2\Omega} = \frac{V^2}{R} \Rightarrow V_{2\Omega} = 3 \left(\frac{2}{2+1.25} \right) = 3 \left(\frac{2}{3.25} \right) = \boxed{1.85 \text{ V}}$$

$$\therefore P_{2\Omega} = \frac{V^2}{R} = \frac{(1.85)^2}{2} = \boxed{1.71 \text{ W}}$$

Q3) An initially uncharged 1-mf capacitor has the current shown in the fig. Find and draw the capacitor voltage. What is the energy stored in the capacitor at $t=1$ s & at $t=5$ s (6 marks)



$$V_c(t) = V_c(t_0) + \frac{1}{C} \int_{t_0}^t i_c(t) dt$$

$$V_c(0) = 0$$

$$0 < t < 2 \text{ sec}$$

$$V_c(t) = V_c(0) + \frac{1}{C} \int_0^t i_c(t) dt = 0 + \frac{1}{1 \times 10^{-3}} \int_0^t 2t dt \times 10^{-3}$$

$$= \frac{(2t^2)}{2} \Big|_0^t = t^2$$

$$V_c(2) = 2^2 = 4 \text{ V}$$

$$2 < t < 4 \text{ sec}$$

$$V_c(t) = V_c(2) + \frac{1}{C} \int_2^t i_c(t) dt = 4 + \frac{1}{1 \times 10^{-3}} \int_2^t 0 dt \times 10^{-3} = 4 \text{ V}$$

$$V_c(4) = 4 \text{ Volts}$$

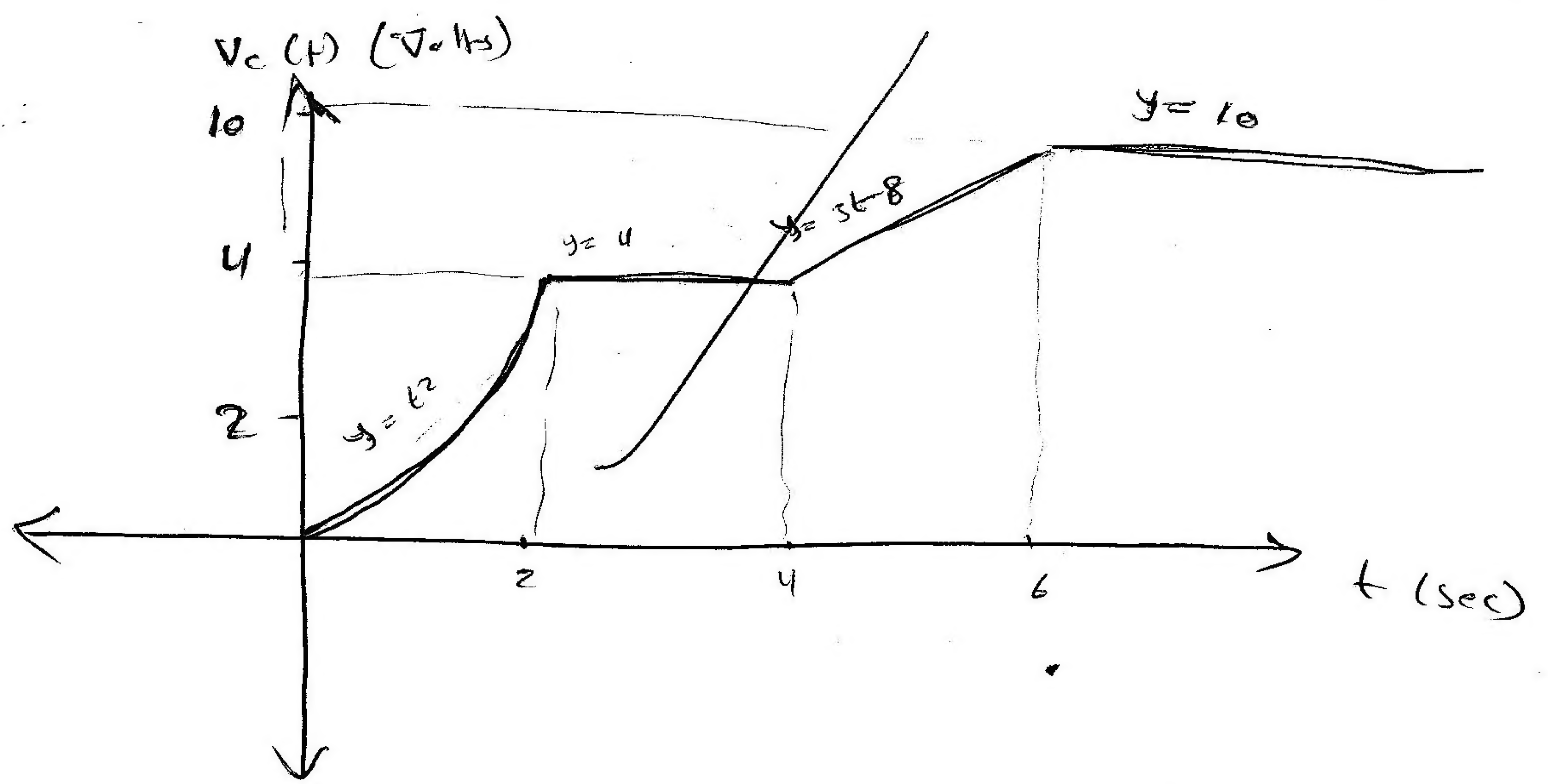
$$4 < t < 6 \text{ sec}$$

$$V_c(t) = V_c(4) + \frac{1}{C} \int_4^t i_c(t) dt = 4 + \frac{1}{1 \times 10^{-3}} \int_4^t 3 dt \times 10^{-3} = 3t \Big|_4^t = 3t - 12$$

$$V_c(6) = 3(6) - 12 = 18 - 12 = 6 \text{ V}$$

$$t > 6 \text{ sec}$$

$$V_c(t) = 6 + \int_6^t 0 \times 10^{-3} dt = 6 \text{ V}$$



$$W(1s) = \frac{1}{2} C (V_c(1))^2$$

$$V_c(1) = (1)^2 = \boxed{1}$$

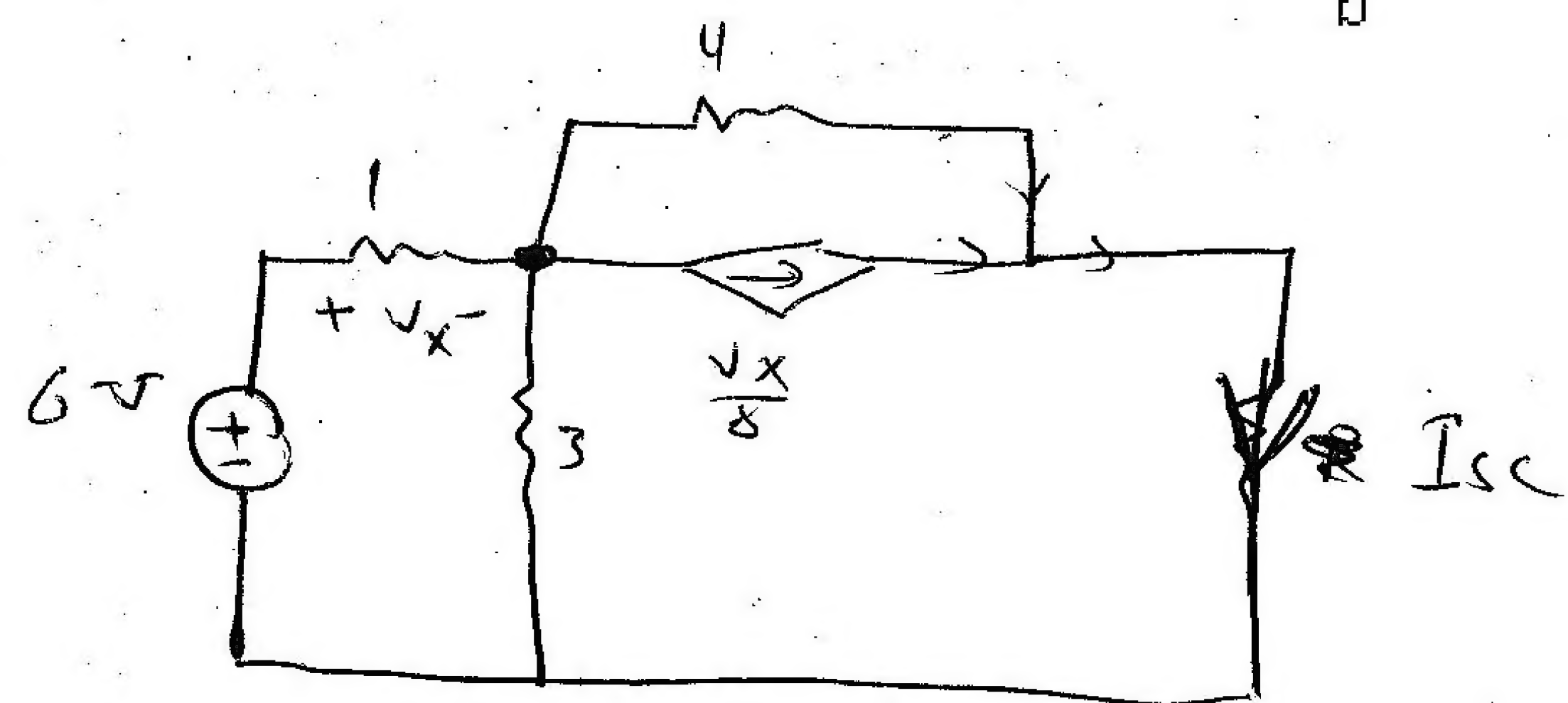
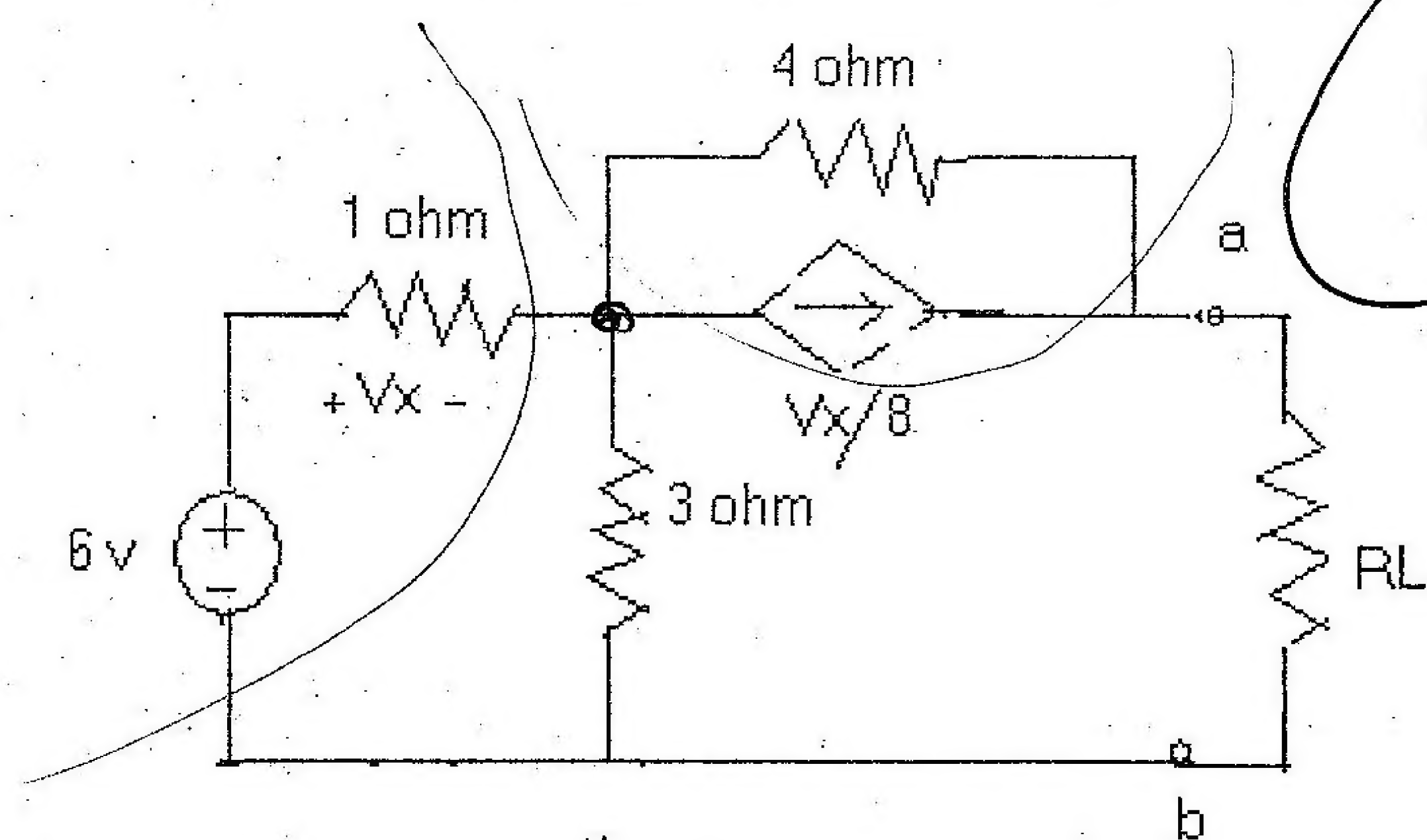
$$\begin{aligned} \therefore W(1s) &= \frac{1}{2} \times 1 \times 10^{-3} \times (1)^2 = \frac{1}{2} \times 10^{-3} \\ &= 0.5 \times 10^{-3} \text{ W} \\ &= \boxed{0.5 \text{ mW}} \end{aligned}$$

$$W(5s) = \frac{1}{2} C (V_c(5))^2$$

$$V_c(5) = 3(5) - 8 = 15 - 8 = \boxed{7}$$

$$\begin{aligned} \therefore W(5s) &= \frac{1}{2} C (7)^2 = \frac{1}{2} \times 1 \times 10^{-3} \times 49 \\ &= 24.5 \times 10^{-3} \\ &= \boxed{24.5 \text{ mW}} \end{aligned}$$

Q4) In the circuit below find the Norton equivalent between a & b. What is the value of R_L for maximum power transfer. Find the maximum power transferred to the load. (6 marks)



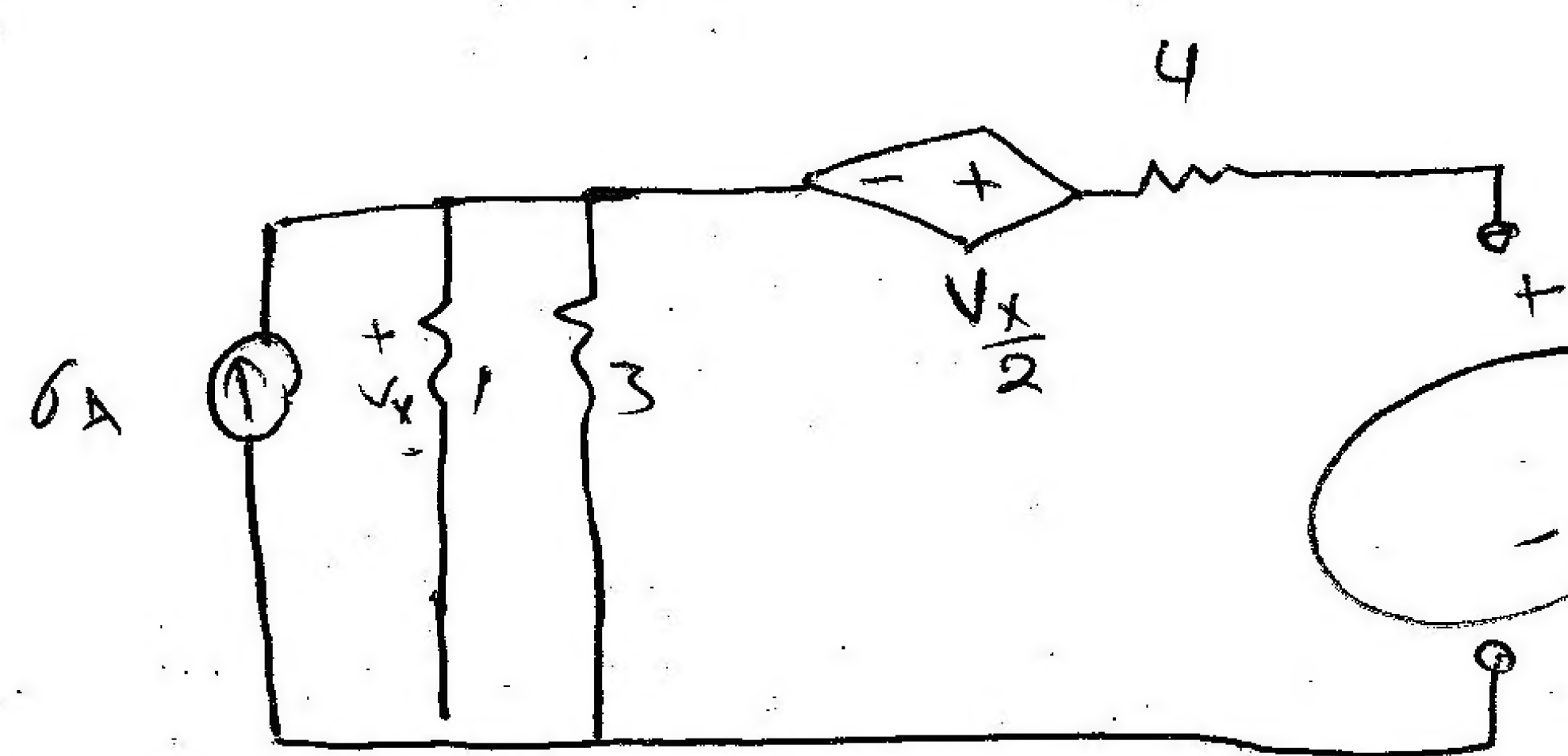
* Find I_{sc}

$$I_{sc} = \frac{6}{4} + \frac{V_x}{8}$$

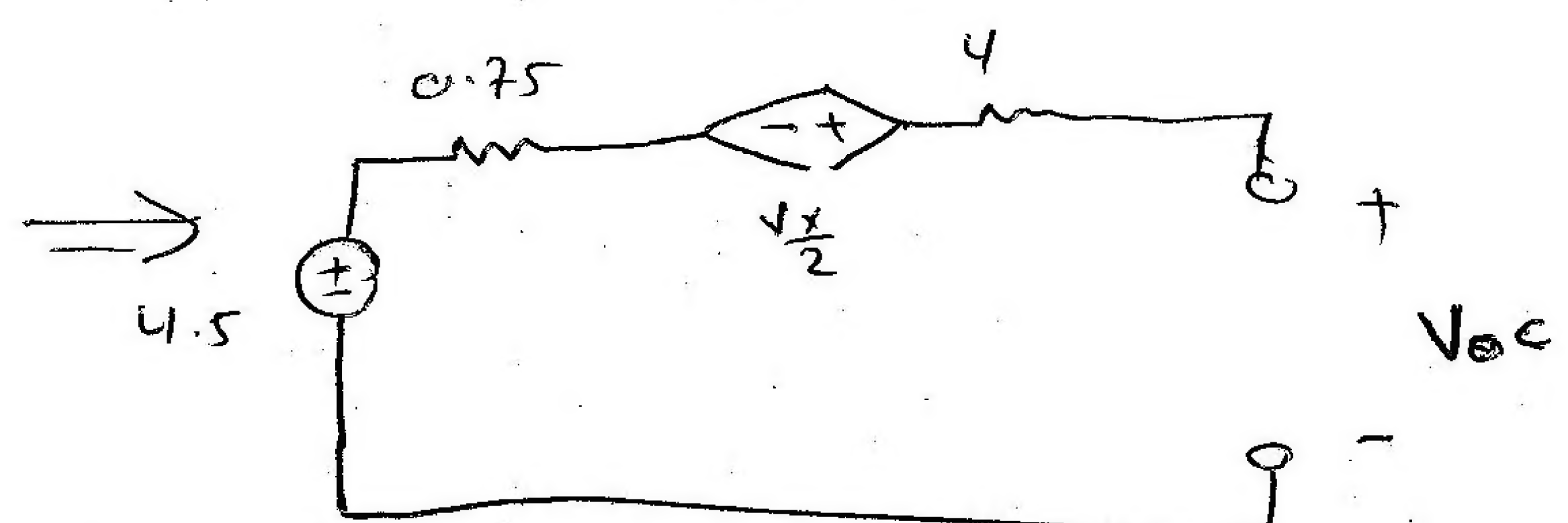
$V_x = 6V$

$$\therefore I_{sc} = \frac{6}{4} + \frac{6}{8} = 1.5 + 0.75 = \boxed{2.25 A}$$

* To find V_{oc} (using Transformation) :-



$$1 || 3 = \frac{1 \times 3}{1+3} = \frac{3}{4} = 0.75$$



$$4I + \frac{V_x}{2} + 0.75I + 4.5 - V_{oc} = 0$$

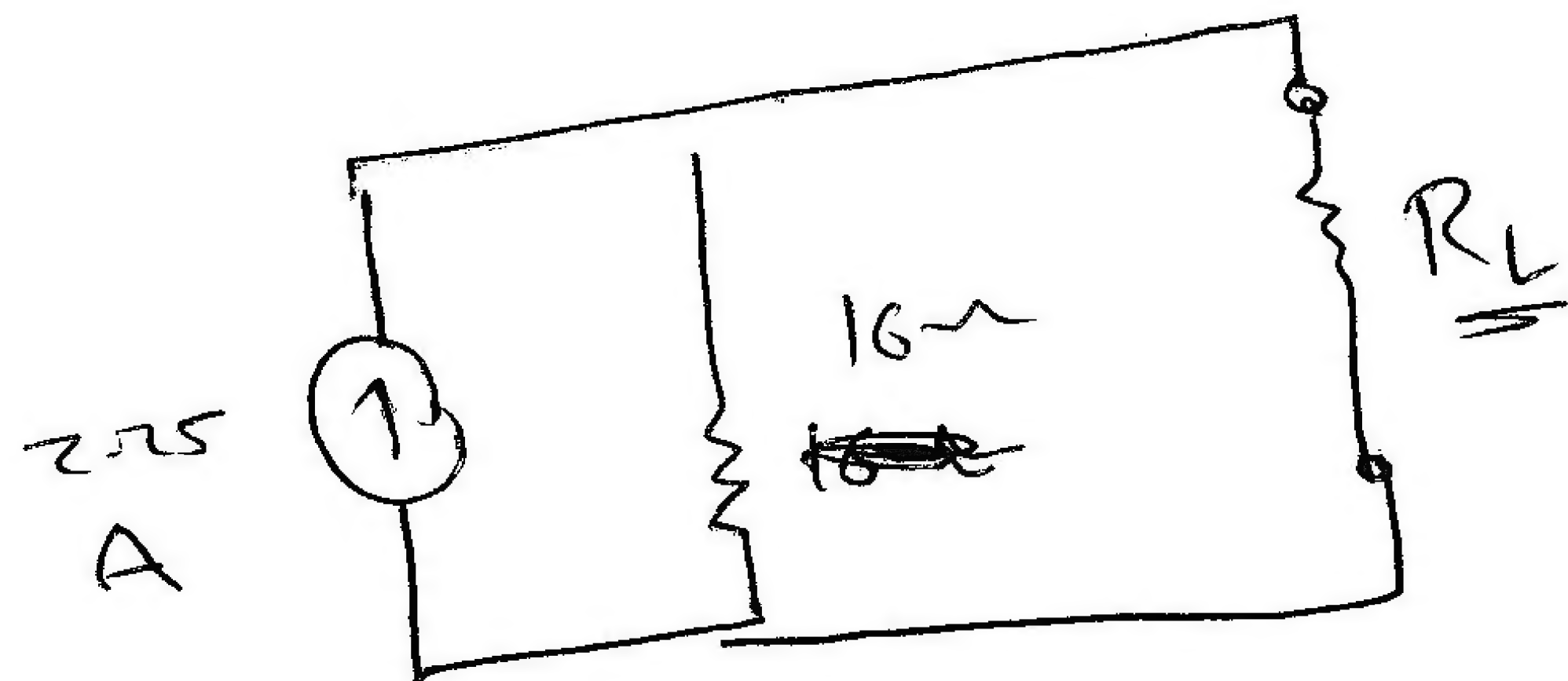
$$V_{oc} = 4(6) + \frac{6}{2} + 0.75(6) + 4.5$$

$$= 24 + 3 + 4.5 + 4.5$$

$$= \boxed{36 V}$$

$$\therefore R_N = \frac{V_{oc}}{I_{sc}} = \frac{36}{2.25} = \boxed{16 \Omega}$$

Norton Equivalent Circuit

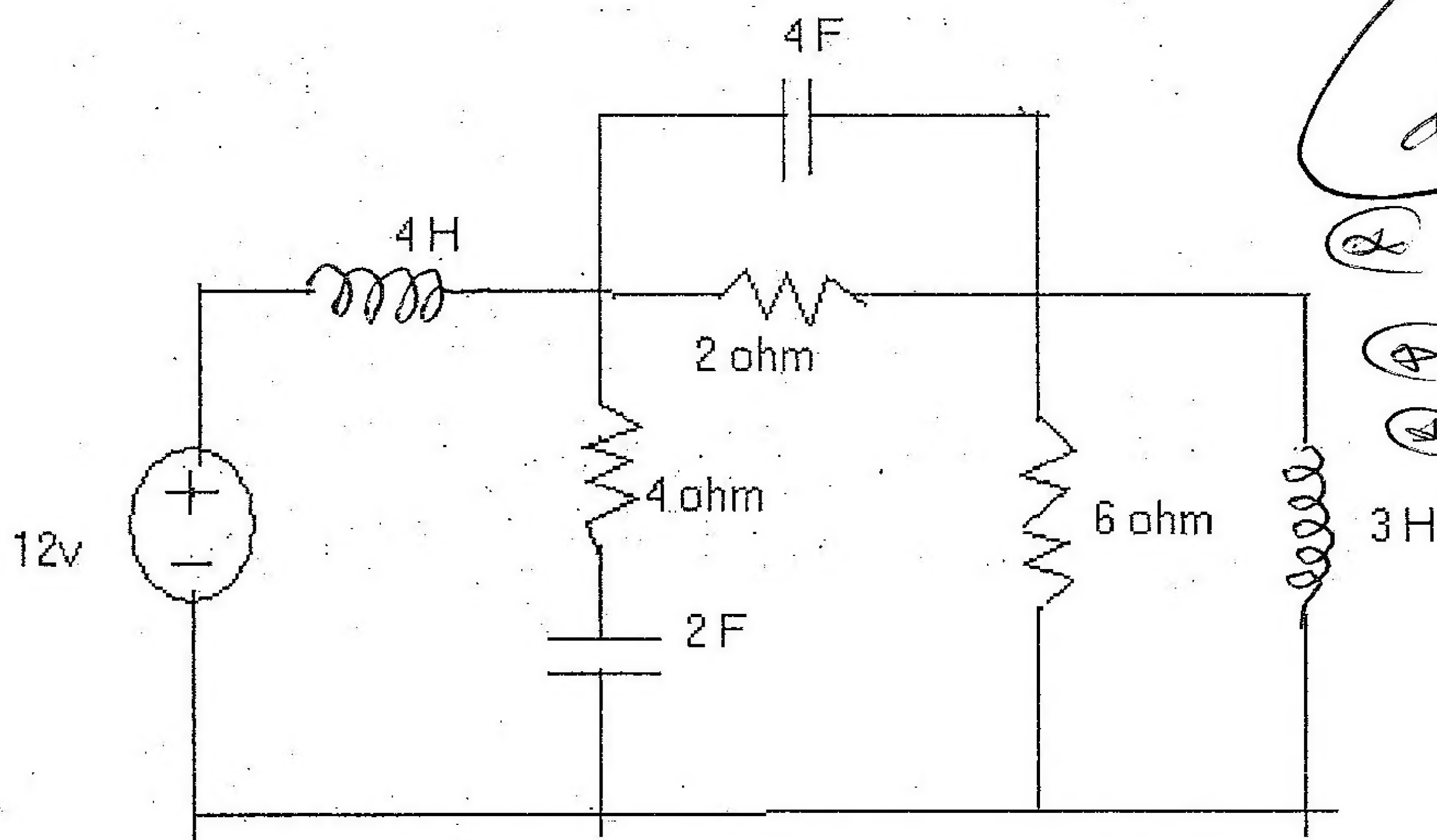


The value of R_L for maximum Power Transfer

$$\begin{aligned} R_L &= R_s \\ \therefore R_L &= 16 \Omega \end{aligned}$$

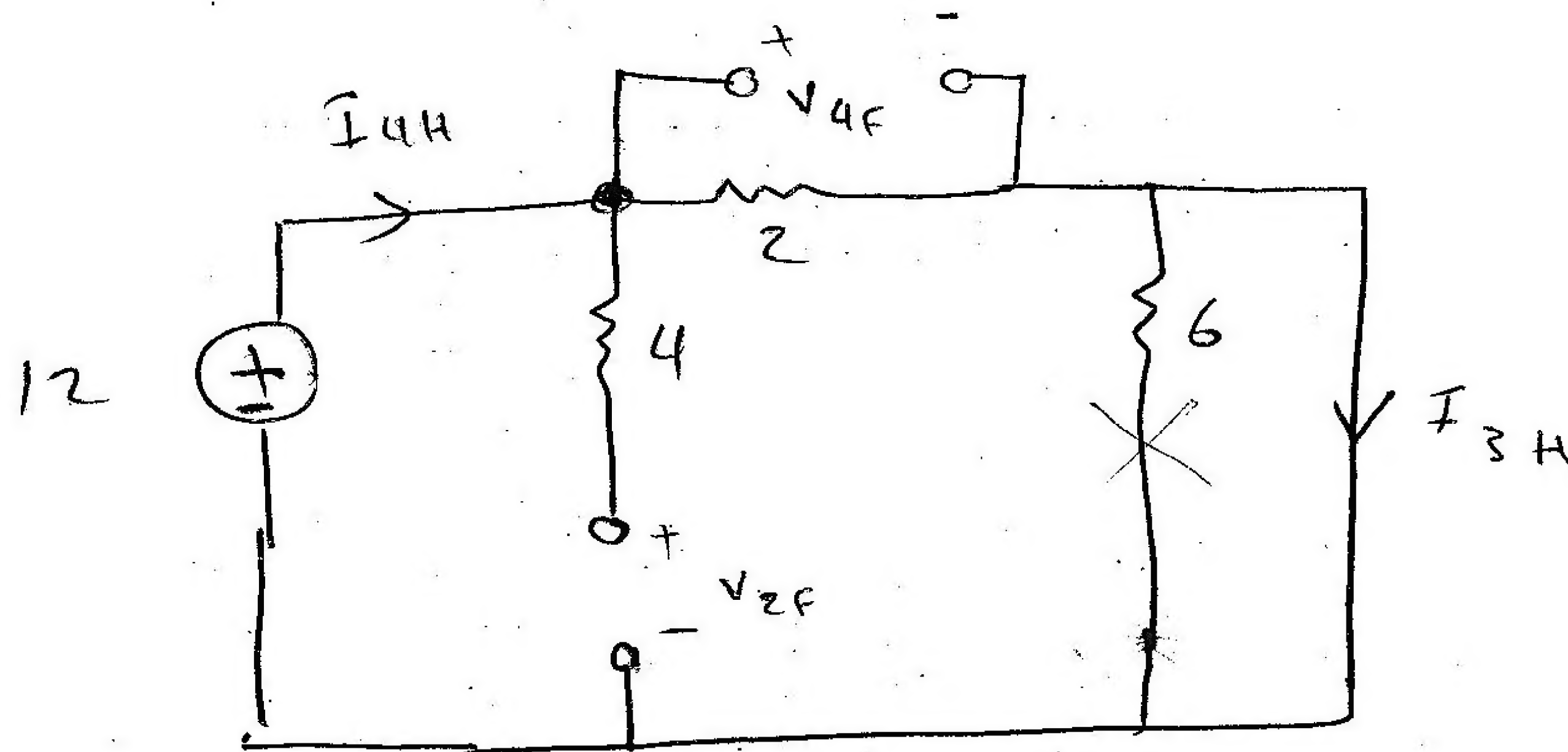
$$P_{\max} = \frac{V_{oc}^2}{4R_L} = \frac{(36)^2}{4(16)} = \frac{1296}{64} = 20.25 \text{ W}$$

Q5) The circuit below is under dc conditions, Find the energy stored in each capacitor and inductor (6 marks)



- Under dc condition
- Capacitor is open circuit
 - Inductor is short circuit

Important



~~$V_{2F} = V_S = 12V$~~

* $I_{tot} = I_{4H} = \frac{12}{2} = 6A \Rightarrow W(4H) = \frac{1}{2} L i^2 = \frac{1}{2} \times 4 \times (6)^2 = \frac{1}{2} \times 4 \times 36 = 72W$

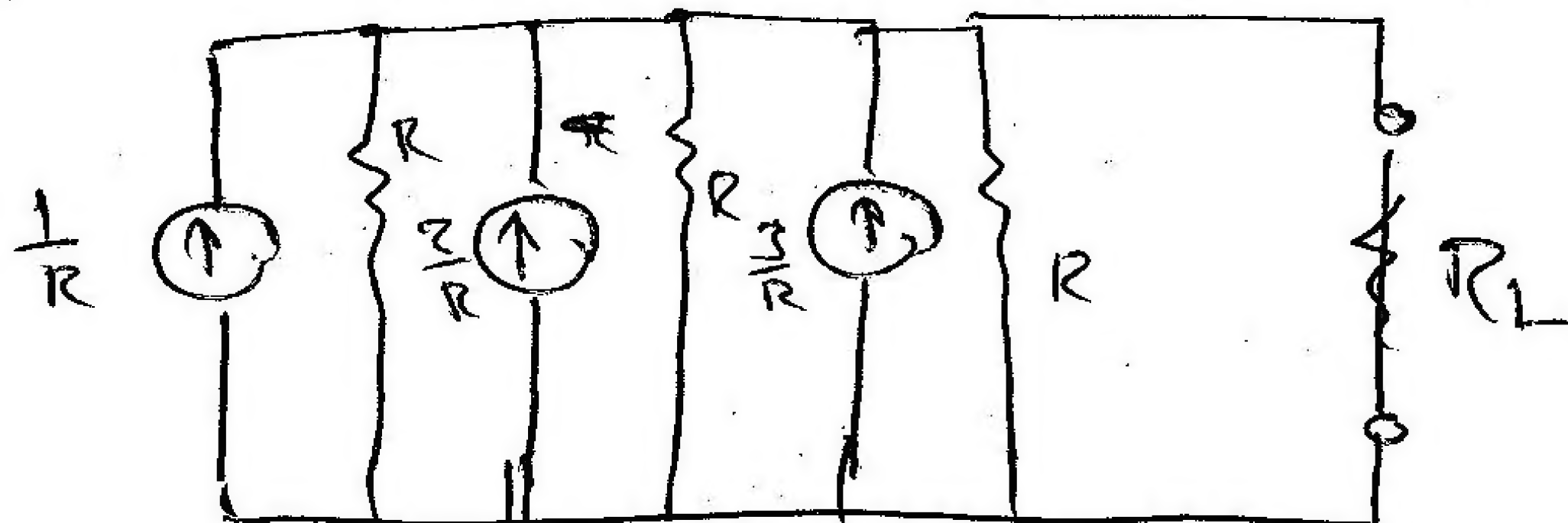
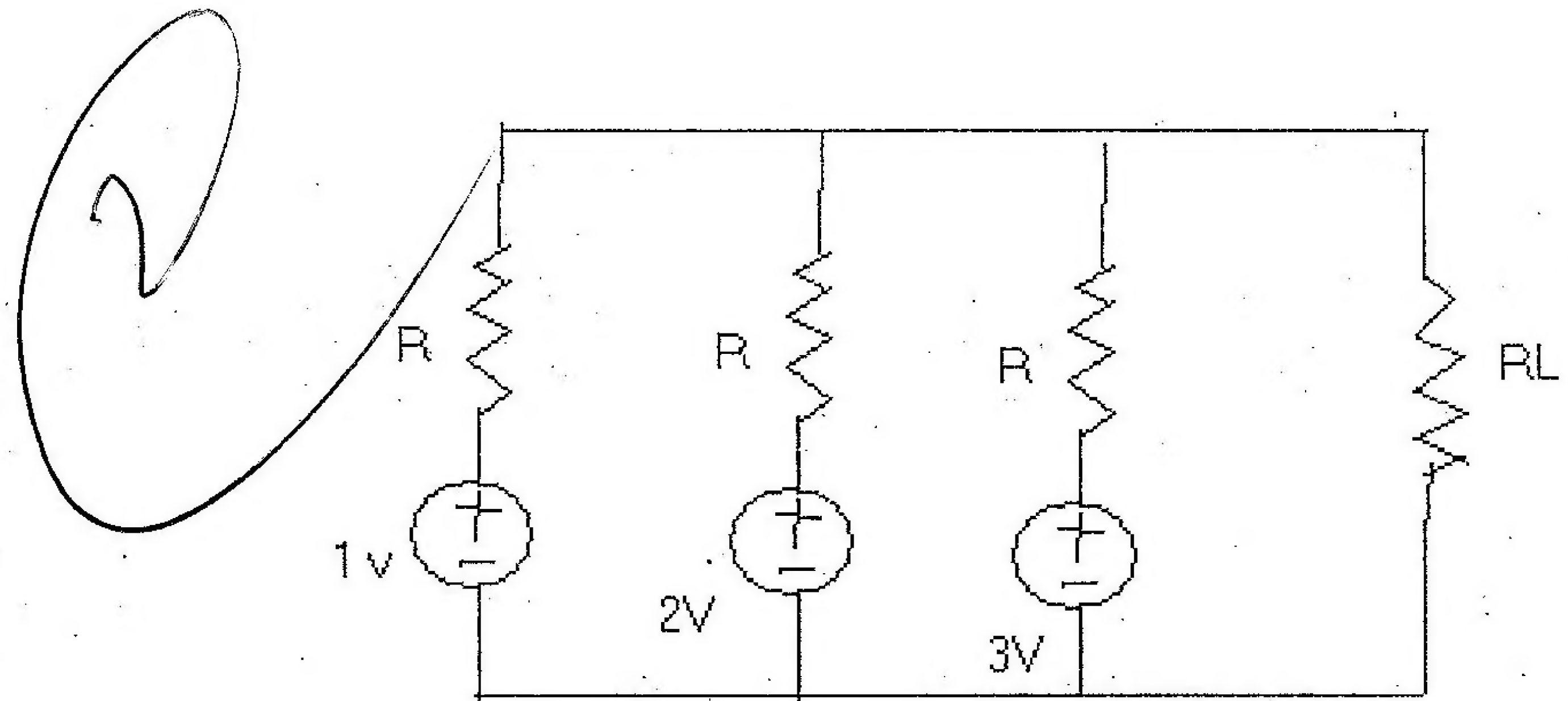
* $V_{2F} = V_S = 12V \Rightarrow W(2F) = \frac{1}{2} C V^2 = \frac{1}{2} \times 2 \times (12)^2 = 144W$

* ~~V_{4F}~~ $I_{3H} = I = \frac{12}{2} = 6A \Rightarrow W(3H) = \frac{1}{2} L i^2 = \frac{1}{2} \times 3 \times (36) = 54W$

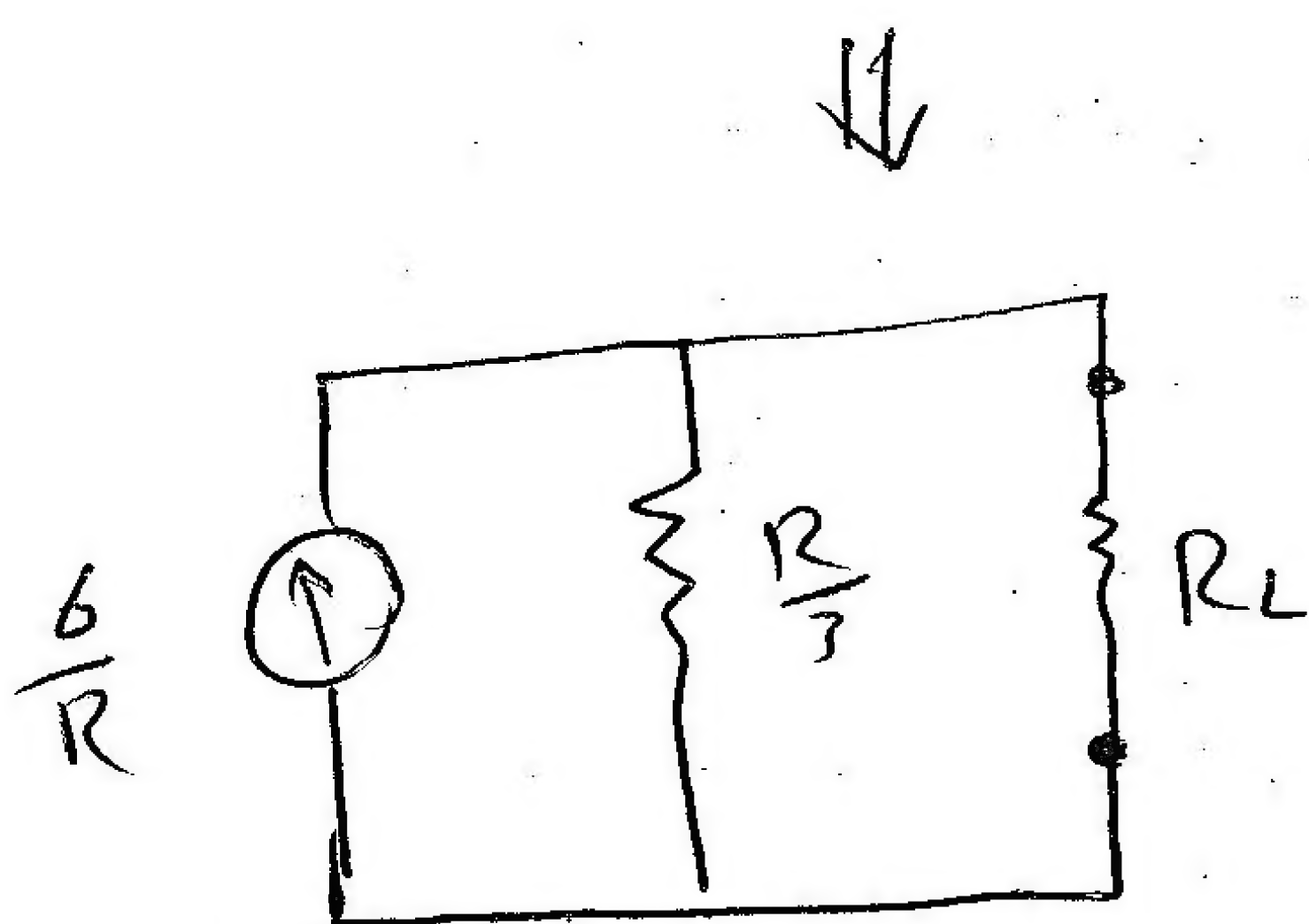
* $V_{4F} = V_{2ohm} = 12V \Rightarrow W(4F) = \frac{1}{2} C V^2 = \frac{1}{2} \times 4 \times (12)^2 = 288W$

Note : This question is Bonus if you solve it you take more marks

Q6) In the circuit below the maximum power transferred to the load is 2 m W Find the value of R (3marks)



$$\frac{1}{R} + \frac{2}{R} + \frac{3}{R} = \boxed{\frac{6}{R}}$$



$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

$$\therefore R_{eq} = \boxed{\frac{R}{3}}$$

$$\otimes V_o = IR = \frac{6}{R} \left(\frac{R}{3} \right) = \frac{6}{3} = \boxed{2V}$$

$$\otimes P_{RL} = \frac{V^2}{R_L} \Rightarrow 2 \times 10^{-3} = \frac{4}{R_L}$$

$$\otimes \Rightarrow R_L = \frac{4}{2 \times 10^{-3}} = 2 \times 10^3 = \boxed{2k\Omega}$$

$$\otimes \therefore \text{for maximum Power Transfer} \Rightarrow R_L = R_s = \boxed{2k\Omega}$$

$$\therefore \frac{R}{3} = 2k\Omega \Rightarrow \boxed{R = 6k\Omega}$$

$$\Rightarrow \boxed{R = 6k\Omega}$$

Good Luck
Mahmoud Ahmad